NOTE ON THE ANATOMY OF THE LARVA OF THE EUROPEAN OYSTER, *OSTREA EDULIS*, Linn.

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PLATE XX.

Ever since Huxley[1] first pointed out that the single adductor muscle of the "black spat" larva of the oyster was the anterior adductor, and therefore not the morphological homologue of the single muscle of the adult, which is the true posterior adductor, students of lamellibranch anatomy have awaited with anxiety the discovery of the di-myarian stage which Huxley had practically prophesied.

Our patience was at length rewarded, for in 1888 Jackson described the true and undoubted di-myarian stage for the American oyster, *O. Virginiana*.[2] An examination of his figures will at once show the reason why Huxley[1] and Horst[3] were unable to find the stage, their specimens being in the black spat stage, still within the shell of the parent, while Jackson's di-myarian stage was a recently attached young oyster, with a disappearing velum and well-developed gills.

The most recent contribution to this subject is a short note by Mr. W. M. Webb[4]: this is a description of a supposed di-myarian stage in the "native" oyster.

Mr. Webb's material consisted of preparations of white and black spat obtained at Brightlingsea, which showed very little beyond the alimentary canal, his most important observations being based on the brief study of two slides of black spat belonging to the Royal College of Science, one being a preparation made by Horst and the other by Huxley, these slides being the material from which Huxley's figures (probably composite ones) were made.

From this material Mr. Webb has constructed a figure[5] which, if examined alone, would leave no doubt in the mind of anyone, that he had discovered the di-myarian stage in the native oyster. Fortunately, in his description he is not quite so positive as in the figure, but he comes to the conclusion that he has discovered the "incipient condition" of the posterior adductor muscle. Now as these actual specimens had been examined both by Horst and Huxley, or

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[1] The English Illustrated Mag. 1883, p. 112.

[2] Proc. Bost. Soc. Nat. Hist., vol. xxiii, 1888, p. 531; also Mem. Bost. Soc. Nat. Hist., vol. iv, 1890, p. 300.

[3] Quart. Journ. Micro. Sci., vol. xxii, 1882, p. 341; and Tijdschr. der Ned. Dierk. Ver. Suppl. Deel, i, p. 6, fig. 16, 1883–84.

[4] Journ. Malacol., vol. iv, 1895.

[5] *l.c.*, pl. i, fig. 1.

by Huxley alone, and by the latter especially with a view as to the presence or absence of a posterior adductor muscle, I could not help entertaining some doubt as to Mr. Webb's figures.

These specimens, being under my care, have often been examined by me; but I made a further examination of them with Mr. Webb, and have subsequently made a careful and renewed study of them, and I here append a short account of them, since the conclusions to which I have come differ *in toto* from those put forward by Mr. Webb. Horst's black spat are stained with hæmatoxylin, and one specimen shows more details than any other I have examined. Huxley's specimens are stained with eosin, and, in spite of the diffuse nature of the stain, show almost the entire structure. Fig. 1 is a *camera lucida* drawing made from the best specimen on Horst's slide: this is certainly *not* the one from which Huxley's drawing was made. The velum (*v.*) is well protruded, but its cilia are not so distinct as in other specimens; in the centre of this structure is seen a depression and epidermal thickening, the supra-œsophageal ganglion (*c.g.*); below the velum is the mouth (*m.*), leading into a broad œsophagus, which in turn communicates with a large stomach (*st.*), partially subdivided into two chambers, an anterior one receiving the œsophagus and the paired hepatic diverticula (*hd.*), while the posterior gives origin to the intestine (*i.*), which runs back, then upwards and forwards, to the *left* of the stomach, as in the adult (*vide* Horst, Huxley, and Jackson), not to the right as figured by Webb, and then with a slightly sinuous course the intestine runs down to the small pallial cavity (*p.c.*), where it opens by an anal orifice. Between the mouth and anus is a lobe of the body capable of being protruded from between the valves: this is the future molluscan foot (*f.*). In optical section a slight pit-like depression and thickening of the epidermis may be seen: this is obviously the developing, but transitory, pedal ganglion. The edge of the mantle and its continuity with the dorsal outline of the body is seen as a slightly stained layer of epiblast just within the shell.

The retractor velar muscles appear as delicate bands of fibres originating from the curvature of the shell near its dorsal margin by two heads, and inserted among the epiblastic cells of the velum. There are four of these muscles, viz., a pair of anterior or dorsal, and a pair of posterior or ventral ones. The anterior ones (*a.v.r.*) lie on either side of the stomach, while the posterior ones (*p.v.r.*) start close to the anus, and, skirting the edge of the pallial cavity, pass on either side of the œsophagus to the velum. In connection with these may be seen some minute pedal retractors.

The functional adductor at this stage is situated dorsally to the stomach, exhibiting in its relation to the shell all the characteristic features of the anterior adductor of the typical di-myarian lamellibranch. In all the specimens which I have examined the muscle at this stage is quite *free and distinct* from the epiblast of the anterior body wall. When seen in surface view the fibres composing this muscle exhibit polygonal ends abutting against the under surface of the shell, but their fibrous nature is best seen in specimens viewed from the end or from below (Figs. 2 and 3). The muscular fibres

stain to a yellowish red with hæmatoxylin, while the epiblastic cellular structures stain much bluer: thus one can readily distinguish the muscular tissue from the more cellular tissue composing the other organs.

Just in front of the anus, *and directly connected with the epiblast*, is a rounded mass of cells (Fig. 1, *o.g.*), figured as such by Horst (*loc. cit.*, Fig. 12) and Huxley (*loc. cit.*, Fig. 1). The latter did not delineate the cellular nature in this or any other organ, but a reference to his original drawing shows that he did not regard this as a muscular structure, for he has coloured all such structures red, while this is coloured brown with the epiblast.

A very careful examination of this structure under a higher power shows that it does not reach the under surface of either valve, but is a knob-like mass of epiblast extending into the body tissue. Now it is well known that muscles arise from the mesoblast, and not directly from the epiblast. At the stage now under consideration the cells constituting the mesoblast are scattered through the body, and not as yet specially aggregated in the position of the future posterior adductor muscle. Further, the posterior velar and the pedal retractor muscles pass on either side of this mass, or, when viewed from the side (Fig. 1), above and below it, thus cutting it off completely from the shell.

This epiblastic cellular mass, in all probability, represents the "anlage" of the so-called parieto-splanchnic (olfactory) ganglia, just appearing. It is not the posterior adductor muscle, as stated by Webb, and his figure does not represent its true relationships. The fibres represented in his fig. 2 at "p.add." do not exist.

I conclude, then, that the di-myarian stage of *Ostrea edulis* has not yet been discovered, although it is undoubtedly passed through. So far, the specimens examined have been too young, and it will be probably found, as Jackson found it, in a newly attached oyster, not in an embryo still contained in the brood chamber of the parent.

EXPLANATION OF PLATE XX.

List of Abbreviations.

a.a.	anterior adductor muscle.	o.g.	? olfactory ganglion.
a.v.r.	anterior velar retractor.	p.c.	pallial chamber.
c.g.	cerebral ganglion.	p.g.	vestigial pedal ganglion.
h.d.	digestive diverticula.	p.v.r.	posterior velar retractor.
f.	foot.	st.	stomach.
i.	intestine.	v.	velum.
m.	mouth.		

Figures all drawn with *camera lucida*. × 400.

Fig. 1. Side view of "black spat" stage of the European oyster, from a specimen prepared by Van Horst.
,, 2. Antero-dorsal view of another specimen of the same age.
,, 3. Antero-ventral aspect of a contracted specimen.